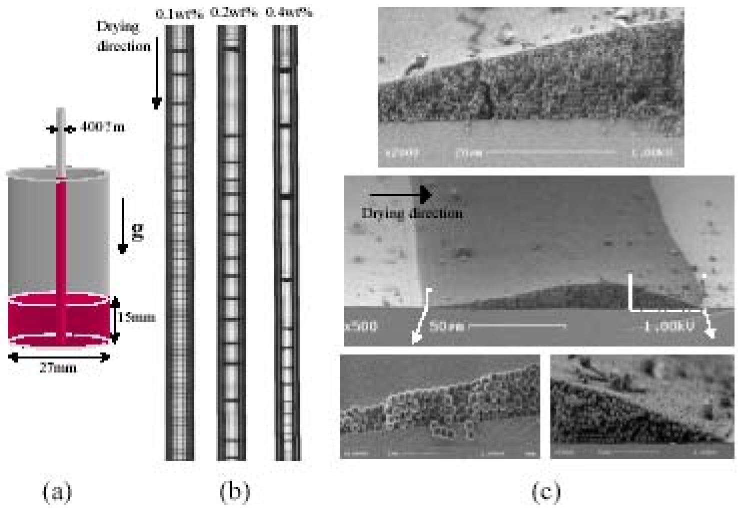
Coating Curved Surfaces with Colloidal Crystals

Howard A. Stone



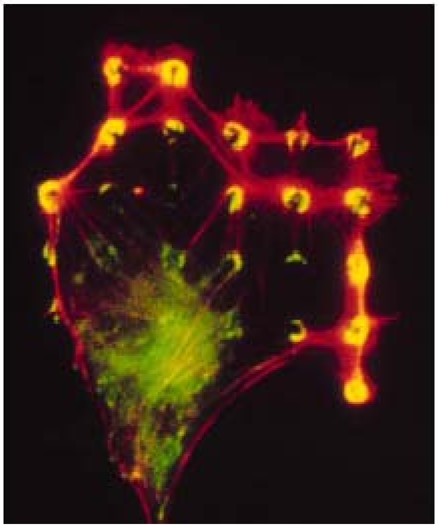
(a) *Experimental setup: a glass capillary of 400 μm diameter is maintained vertically in an open glass bottle containing a solution of ethanol and polystyrene particles (0.5 μm diameter). The system is allowed to dry for at least several hours in an oven at 65°C.*

(b) *Optical microscopy reconstruction of the ring patterns observed along three capillaries for three different concentrations of the particles. The black lines represent particle deposits.*

(c) *SEM pictures of a band structure in the capillary (0.2 wt% particles). The top picture shows a close-up of the middle of a band, which is flat, inclined relative to the substrate, and contains closed-packed crystalline structures. The middle picture shows one band, with the drying direction indicated, and the two bottom images show respectively, on the left, the step structure at the beginning of the band and on the right, the smooth surface at the end. (We thank D. Bell for technical support with the SEM pictures.)*

Controlling Cell Shape

Donald E. Ingber and George M. Whitesides

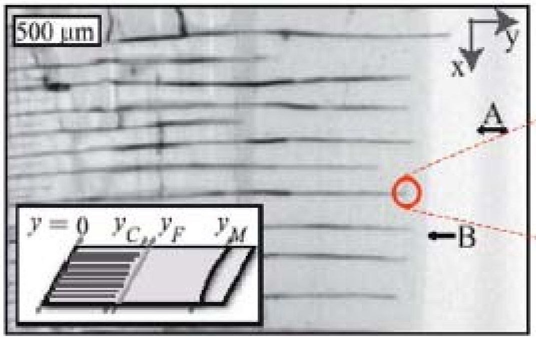


Cell motion and spreading is a critical cellular function, and are mediated by binding of transmembrane integrin receptors and associated formation of focal adhesions (FA) which link the integrins to the contractile actin cytoskeleton, which provides mechanical integrity to the cell. **Ingber** and **Whitesidses** recently used soft lithography to pattern the shape of the regions to which cells can adhere, and showed that this shape regulates the events that drive focal adhesion assembly through changes in the level of cytoskeletal tension that is exerted on integrin binding sites. These findings demonstrate the existence of an "inside-out" mechanism whereby global cell distortion produces increases in cytoskeletal tension that feed back to drive local changes in FA assembly. This complex interplay between cell morphology, mechanics, and adhesion may be critical in determining how cells integrate form and function in living tissues.

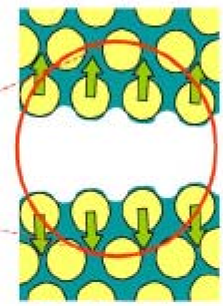
A single cell cultured on a substrate containing multiple small (3 μm) adhesive dots showing actin filaments (red) between focal adhesions (green) that localize to each island.

Fracture in Drying Nanoparticle Suspensions

John W. Hutchinson, David A. Weitz, and X. Sunney Xie



Cracks invade a drying film of silica nanowires.



Drying stresses, up to 1000 times atmospheric pressures, can fracture thisfluid-solid composite material.

Drying is a crucial step in the processing of a variety of materials, from the common coat of paint to emerging photonic band-gap structures. As the suspending fluid evaporates, fracture, delamination, and buckling can ruin the material. Professors **Weitz, Hutchinson** and **Xie** have been exploring drying nanoparticle suspensions, which are particularly prone to fracture. In the nanoparticle regime, drying stresses, originating from the affinity of the fluid for suspended particles, can exceed 1000 times atmospheric pressure. Furthermore, the fluid immersing nanoparticles can behave strangely. Since the gaps between tightly packed nanoparticles are only a few molecules across, fluid molecules can be arrested by strong short-range interactions with the nanoparticles. Recently **MRSEC REU** students have demonstrated the importance of these molecular-scale interactions on the macroscopic dynamics of drying nanoparticle suspensions (to appear in *Physical Review Letters*).

Career Development for Young Scientists

Educational Programs

Chris Holland (REU, Morehouse College, biology major), Valerie Bennett (Asst. Prof. of Physics, Morehouse College) and Prof. Howard Stone (Chem. Eng.) discuss Chris' REU project on microfluidics in Prof. George Whitesides' chemistry laboratory.

David Evans (Senior Admissions Officer, Harvard College) addresses REU students, faculty and mentors at a luncheon sponsored by the Harvard Foundation for Intercultural Relations early in the summer to welcome and support the students.